PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Dies for Cutting External Screw Threads.

(A communication from abroad from the DARDELET THREADLOCK CORPORATION, a corporation organised under the laws of the State of Delaware, United States of America, of 120, Broadway, Borough of Manhattan, in the City, County and State of New York, United States of America.)

I, ERNEST JAMES CROSS, a British Subject, of the firm of Lloyd Wise & Co., of 10, New Court, Lincoln's Inn, in the County of London, Chartered Patent Agents, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to screw thread cutting dies of the kind having cutting teeth arranged to form an interrupted internal cutting thread of constant root diameter extending around the die axis, a plurality of said teeth, located nearest the leading end of the die, being reduced in size while the remaining teeth are full size. More particularly the invention has reference to an improved formation and arrangement of the cutting teeth of such dies when adapted for cutting self-locking external screw threads and especially screw threads of the system known as "Dardelet threads" or "Dardelet self-locking threads". Such self-locking threads are disclosed in the specifications of U.K. patents No. 242,299 and No. 342,080, the latter of which patent specifications also discloses a tap for cutting the self-locking internal screw thread of said system of screw threads.

The thread groove of the self-locking external thread is wider than usual with respect to the width of the thread rib, which fact requires removal of a large amount of metal to cut the groove and the conoidal root surface of the thread at the bottom of the groove. Owing to the inclination of the root surface and the amount of metal to be removed to generate said surface, dies for cutting the self-locking external thread have a marked tendency to cut out of pitch and out of round, particularly in threading sheared bolt blanks or other stock pieces distorted from true cylindrical form at the end engaged by the die in starting the cutting of the thread. The present invention provides a die for cutting the self-locking thread with precision and with minimum strain on the die, even though the die is provided with very few reduced teeth at its leading end, which die has its reduced teeth so formed that they cut small chips and yet take hold of the stock in a manner such as to prevent improper axial and radial movements of the die relatively to the work piece, which would cause the die to cut out of pitch and out of round, and permit of the first full size tooth cutting a thin chip which is no thicker at one side of the groove than at the other side to cut the conoidal root surface of the thread.

In a die of the kind referred to, according to the present invention each full size tooth and the reduced tooth farthest from the leading end of the die has a flat top cutting edge which inclines towards the die axis in the direction of said leading end, each remaining tooth has a flat top cutting edge which lies parallel to the die axis and teeth which are reduced solely in height and decrease in height in the order of their approach to the leading end of the die alternate in said plurality of reduced teeth with teeth which are reduced from top to bottom thereof at both sides of the cutting thread and which decrease in height in such manner, in the order of their approach to said leading end, that the tops of the complete series of reduced teeth alternately approach and recede from the die axis.

In the accompanying drawings, Fig. 1 is a fragmentary sectional view on the line 1—1 of Fig. 2, showing a bolt thread being chased on stock by the chasers of a die of the type having bar-like chasers disposed in the die head tangentially to the cutting circle of the die;

Fig. 2 a view of the entering end of a well-known type of rotary die in which my thread-cutting improvements are embodied;

Fig. 3 a fragmentary view, partly in longitudinal section, showing a self-locking nut thread in locked position on a self-locking bolt thread of the kind cut by the die;

Fig. 4 a view showing the active or cutting ends of the four chasers of the die of Figs. 1 and 2;

Fig. 5 a perspective view of the uppermost chaser of Fig. 4;

Fig. 6 a diagrammatic view showing the cutting profiles of the groove-developing ribs superposed;

Fig. 7 a view showing, upon an enlarged scale, the cutting action of the ribs of the four chasers in developing the thread groove;

Fig. 8 a plan view showing the grooved face of the first chaser and end portions of the grooved faces of the other chasers;

Fig. 9 a view of the entering end of a well-known type of rotary die of the kind having radially arranged chasers grooved across their inner ends;

Fig. 10 a side view of the improved chasers in the die shown in Fig. 9; and

Fig. 11 a view of the grooved end of the uppermost chaser of Fig. 10.

In the above-mentioned system of self-locking threads, the external and internal threads, as of a bolt and nut respectively, for example, as shown in Fig. 3, are of equal pitch, the rib 20 of the bolt thread and the rib 21 of the nut thread have steep side walls making an angle of fourteen and one-half degrees with the perpendicular to the thead axis, the ribs are much narrower than the thread groove, the bolt thread has a slightly conoidal root surface 22 making an angle of six degrees with the thread axis, and the nut thread has a correspondingly inclined conoidal crest surface 23. When the nut is turned upon the bolt without axial advance, as when tightening the nut, the nut thread is displaced crosswise of the bolt thread, as shown in Fig. 3. Thereby the nut thread crest surface 23 becomes tightly wedged and self-locked upon the bolt thread root surface 22 and one face of the nut thread is brought into abutment with that side face of the bolt thread which faces away from the entering end of the bolt. The crest surface of the bolt thread and root surface of the nut thread lie parallel with the thread axis.

The improved die shown in Figs. 1, 2, 4, 5, 6, 7, and 8 will first be described. The die shown in these views is of the type wherein the serrated chasers 24^a, 24^b, 24^c and 24^d are bar-like chasers arranged tangentially to the cutting circle and each having its thread ribs or teeth extending parallel with its longitudinal side edges. The chaser bars are rigidly clamped in the die head and are canted in the well-known manner so that the ribs extend at an angle to the axis of the cutting circle corresponding, or approximately corresponding with the helix angle of the thread to be cut. Further description of the die head and the chaser mounting is thought to be unnecessary, as the parts and their mountings as so far described are old and well-known.

The ribs upon each chaser include a leading rib located nearest the leading edge of the chaser and designated R^1, R^2, R^3 and R^4 upon the successive chasers, and following ribs R. All of the ribs upon each chaser have a common base line B as indicated in Fig. 4. Each chaser has also a beveled throat surface T extending inward from its leading side edge toward said leading rib of the chaser. Said throat surface T has the same angle and width on all of the four chasers of the die and intersects the common base line or plane B of the series of ribs short of the leading rib of the series. The several series of ribs on the successive chasers of the series of four are progressively offset from the leading side edges of the chasers in the usual manner so that the active or innermost end of the ribs will lie in a helical path around the die axis to form the interrupted internal cutting thread or helical series of successively cutting teeth of the die when the chasers are assembled in the usual manner in the die head H.

The throat surface T of each chaser is connected with the leading rib by a flat or plane surface F coincident with the base line B of the ribs and the flat bottom of the grooves G between the ribs. The surfaces F are of progressively increasing width in successive chasers, having the least width on the uppermost chaser of Fig. 4 and the greatest width on the lowermost chaser of said figure. The chasers are arranged in the order from top to bottom of Fig. 4 in which they act to progressively develop the thread profile. The distance between the flat bottoms of thread grooves G and the flat back of the chaser is the same for all the grooves G of each chaser and for all the chasers. The several ribs R of each chaser are of equal height or depth and the height of these ribs is the same on all the chasers of the die, the profile of the ribs R being identical with that of the groove of the completed Dardelet thread.

The leading rib R^1 of the first chaser 24^a is an initial groove center cutter. It has flat opposite sides, equally and oppositely inclined at a sharp angle to the base line B, and a flat top parallel to said line. In the present instance the angle of inclination of the sides is forty-five degrees, the depth or height of the rib is more than one-half the depth of the thread groove to be cut and the width of the rib is materially less than the groove width. The leading rib R^2 of the follow-

ing chaser 24^b is an initial groove side cutter. It has flat opposite sides, equally and oppositely inclined at an angle of fourteen and one-half degrees to the base line, and a flat top parallel to the base line. Its depth is slightly less than that of the rib R^1 and its width corresponds to that of the groove to be cut. The leading rib R^3 of the following chaser 24^c is a groove center cutter similar in form to the first rib R^1 but larger in cross section. It has a depth of only slightly less than the groove depth and a width at the base line equal, in the present instance, to the groove width at said line. These proportions may be varied, however. The leading rib R^4 upon the following chaser 24^d is a groove side cutter equal to the thread groove in width and having flat sides diverging toward the base line and each making an angle of fourteen and one-half degrees with the perpendicular to said base line; it is of slightly less depth than the groove. This rib has a flat top inclined, in the present instance, at an angle of six degrees to the base line in an opposite direction to the inclination of the throat surface T.

The ribs R of all the chasers also have flat sides diverging toward the base line B and a flat top inclined in the same direction as the top of the rib R^4, said flat top also making an angle of six degrees with the base line, for cutting standard Dardelet threads. Ribs R are slightly deeper than rib R^4, being the full depth of the thread groove to be cut. All of the ribs R and the ribs R^2 and R^4 are the same width at the base, and the grooves G between the ribs R and the grooves between the ribs R^2 and R^4 and the adjacent ribs R are all the same width at the base.

The active or innermost ends of the chasers are ground back to provide the usual beveled or relieved cutting end face C and guide end portion or lead-off portion L on each chaser. In each chaser the face C is extended inward from the leading side edge of the chaser to a point beyond the leading one of the series of full height, inclined top ribs R, and said face C lies in a plane making an angle with the longitudinal side edges of the chaser equal to the helix angle of the thread the chaser is profiled to cut. The active cutting edges of the chasers thus lie parallel with the axis of the die and work piece being threaded, while the end portion L slightly projects beyond the line of cut for more efficient action as a guide or lead screw, as indicated by dotted lines in Fig. 1 and as will be apparent from inspection of Fig. 2. The chasers are so disposed in the die head as to locate the cutting ends of the groove center cutting ribs R^1 and R^3 diametrically opposite each other and to locate the cutting ends of the groove side cutting ribs R^2 and R^4 diametrically opposite each other upon a diameter at right angles to that of ribs R^1 and R^3.

The improved die is well adapted to accurately cut the self-locking external threads upon bolt blanks which have been sheared from a long rod. Such blanks have their tips materially distorted out of round by the transverse shearing pressure. Usually the tip is distorted into a three-cornered or three-lobed form in cross section, and dies employed heretofore failed to properly grip the distorted tip and cut threads with accurate conoidal root surfaces and a rib of the proper thickness at the tip. The bolt blank was free to vibrate transversely in the die and recede somewhat from the cutting ribs or teeth. Consequently the ribs failed to cut deeply enough and the thread root surface at the top of the bolt had raised spots along its length. Sometimes these raised spots would interfere with the free screwing of the nut upon the bolt tip. Also, the insufficiently gripped blank would sometimes vibrate longitudinally and cause the thread rib to be cut thinner than the normal width at the tip of the bolt. The chuck supporting the bolt blank is usually pressed forward to feed the blank into the die and if the blank is not firmly gripped by the die the blank is thrust rearward by the cutting resistance and said thinning of the thread rib occurs at the tip. The improved die has been designed to firmly grip the stop, prevent both transverse and longitudinal vibration and ensure the cutting of an accurate thread. It is most desirable in the self-locking external thread that the inclined root surface be accurately formed for proper locking cooperation with the inclined crest surface of the self-locking nut thread.

In operation, the inner end edges of throat surfaces T of the chasers will act as cutting and guiding edges, to center and guide in an oversized work piece or blank and taper it down when necessary, and the chaser portions F of the chasers will, when necessary, act as cutting edges to bring oversized or distorted stock to proper nominal diameter in advance of the starting of a thread groove in the work piece. The rib R^1, being the most advanced of the leading ribs, first engages the piece and makes an initial central groove cut of approximately V form, of material depth and entirely clear of the groove sides. The following rib R^2, of greater width than rib R^1 and of nearly

equal depth, trims away the metal at opposite sides of the first cut and develops the opposite sides of the thread groove for approximately half the depth of the groove. The following tapered rib R^3 makes a central cut reaching to almost the bottom of the groove and entirely clear of the groove sides. The following rib R^4 trims away the metal at opposite sides of said second central cut and develops the groove sides to almost the bottom of the groove. The rib R^4 is followed by that one of the ribs R of the first chaser 24^a nearest to the initial cutting rib R^1. This rib R completes the bottom and sides of the groove and is required to take only a narrow chip. The remaining ones of the identically formed ribs R of the chasers travel in the completed groove and serve to guide the work piece and to do any cutting necessary to insure an accurately and smoothly finished groove.

It will be observed that the reduced leading ribs of the chasers are proportioned both for a rather deep penetration and for a positive gripping of the piece without the taking of an objectionably large chip by any one of said ribs. The chips taken by the four reduced leading ribs are very nearly equal, while the final groove bottom cut which develops the important inclined root surface of the thread is desirably thin and is no thicker at one side than at the other, thus ensuring very accurate cutting of the conoidal root surface of the locking thread. The wedge-like groove center cutting ribs firmly grip the work piece while the groove side cutting ribs are cutting, and all four of the deeply penetrating reduced leading ribs firmly grip the work piece while the groove bottom rib is cutting. Therefore, the thread cut will, throughout its length, be accurate in pitch, will have an accurately formed root surface with no longitudinal undulations forming high spots, and will have a rib of uniform cross-section. It will be understood that the production of an accurate groove upon the distorted tip of the work piece not only prevents objectionable high spots upon the thread root and objectionable thinning of the rib but also causes the groove to accurately fit the guide ribs R of the chasers and thereby ensures accurate guiding of the piece through the die and accurate cutting of the following turns of the thread.

The modified form of die shown in Figs. 9, 10, and 11 is of the well known type wherein the chaser bars are fixed radially in a die body or shell 27, which has a plurality of axially directed slots 27^a and is embraced by a split adjusting collar 26 and are, in effect, segments of a nut, the grooves and ribs and the surfaces F and T extending across the concave inner end edges of the chaser bars, said grooves and ribs forming an interrupted cutting thread as is usual in this type of die. The inner edges of the series of chasers 25^a, 25^b, 25^c and 25^d of this modified form of die are profiled, as heretofore described in connection with chasers 24^a, 24^b, 24^c and 24^d, in accordance with this invention. It will be obvious that the invention may be embodied in other types of thread cutting dies than those shown.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. For cutting self-locking external screw threads, a die having its cutting teeth arranged to form an interrupted internal cutting thread of constant root diameter extending around the die axis, a plurality of said teeth, located nearest the leading end of the die, being reduced in size, while the remaining teeth are full size, wherein each full size tooth and the reduced tooth farthest from the leading end of the die has a flat top cutting edge which inclines toward the die axis in the direction of said leading end, each remaining tooth has a flat top cutting edge which lies parallel to the die axis and teeth which are reduced solely in height and decrease in height in the order of their approach to the leading end of the die alternate in said plurality of reduced teeth with teeth which are reduced from top to bottom thereof at both sides of the cutting thread and which decrease in height in such manner, in the order of their approach to said leading end that the tops of the complete series of reduced teeth alternately approach and recede from the die axis.

2. A die, as claimed in claim 1, wherein the reduced teeth are all located in that convolution of the cutting thread of the die which is nearest the leading end of the die.

3. A die, as claimed in claim 1, wherein the reduced tooth located nearest the leading end of the die is one of the teeth which is reduced at both sides of the cutting thread, and the reduced tooth located farthest from the leading end of the die is one of the teeth which is reduced solely in height.

4. For cutting self-locking external screw threads, a die having its cutting teeth formed and arranged substantially as herein described with reference to Figs. 1, 2 and 4 to 8 or Figs. 9 to 11 of the accompanying drawings.

For the Applicant,
LLOYD WISE & Co.,
Dated the 10th day of January, 1934. 10, New Court, Lincoln's Inn, London, W.C.2,
Chartered Patent Agents.

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Fig. 1.

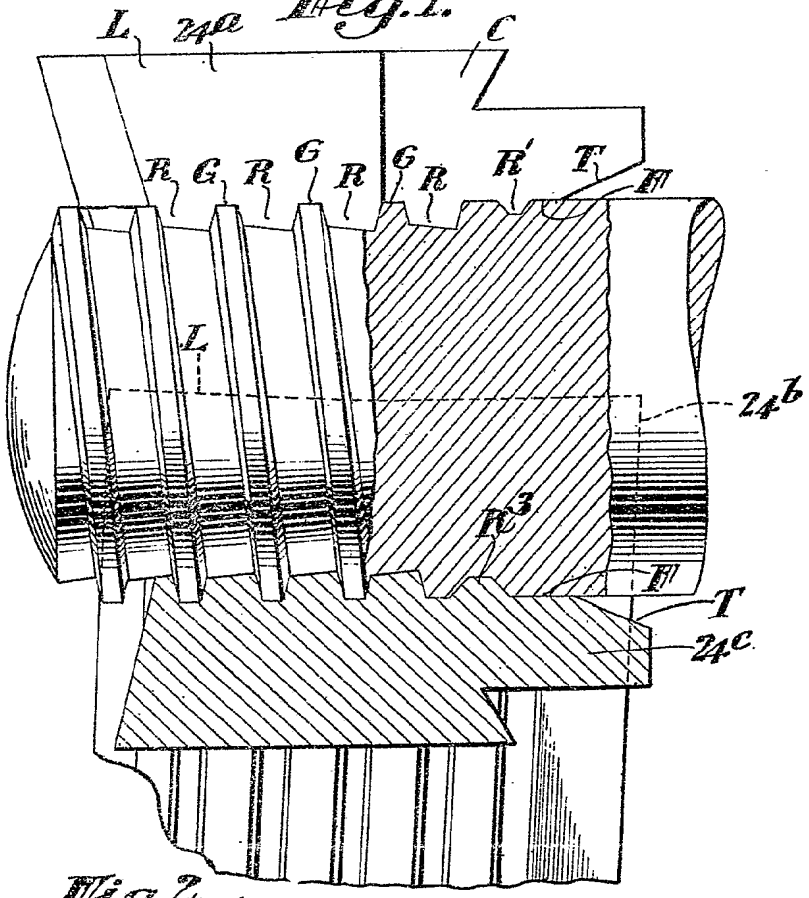


Fig. 2.

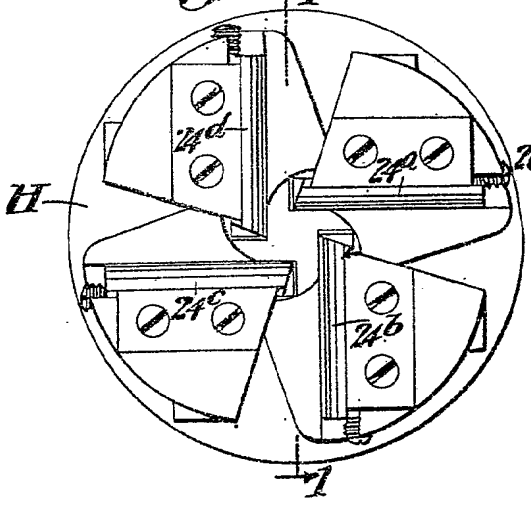
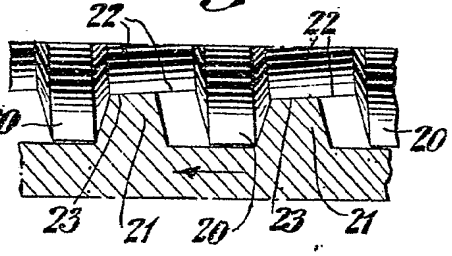


Fig. 3.



2 SHEETS

SHEET 1

SHEET 2

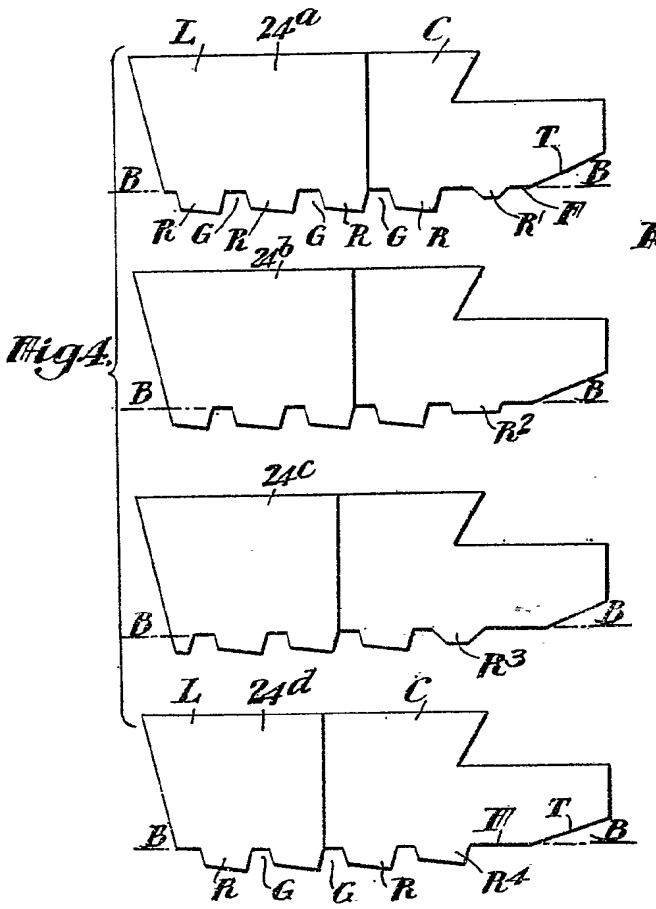


Fig.4.

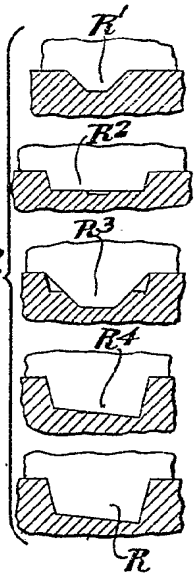


Fig.7.

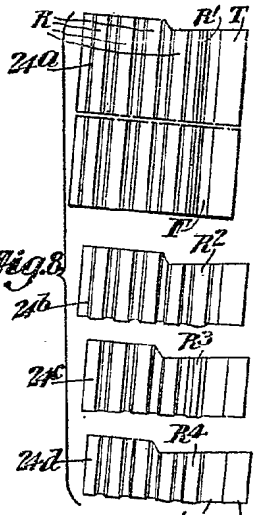


Fig.8.

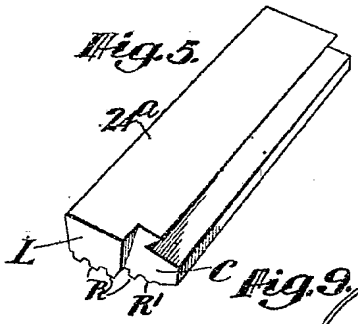


Fig.5.

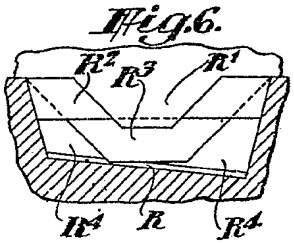


Fig.6.

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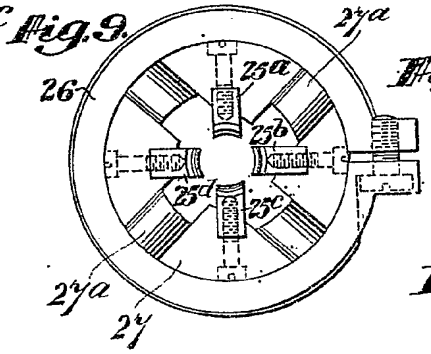


Fig.9.

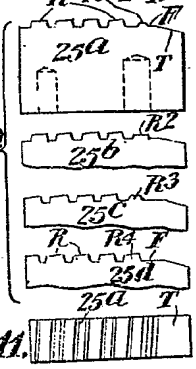
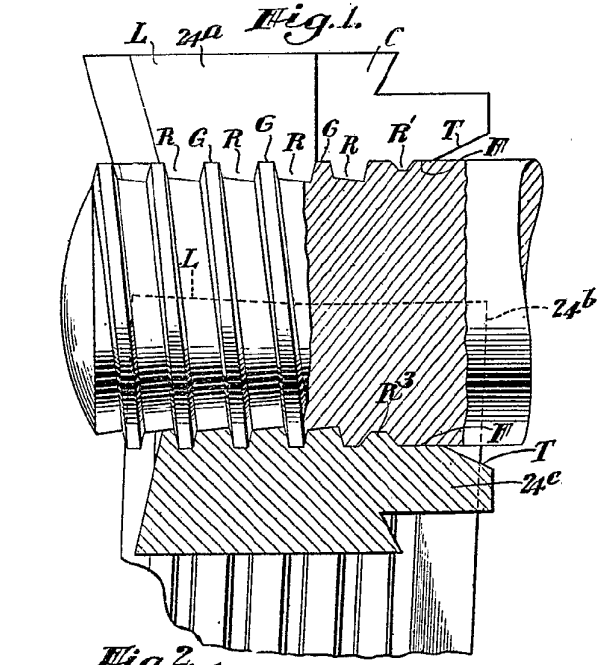


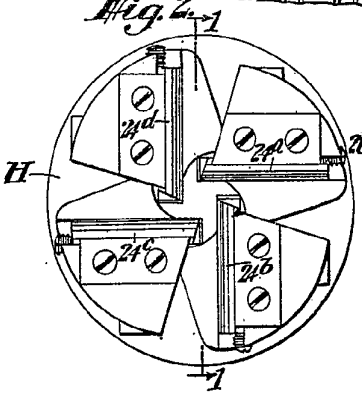
Fig.10.

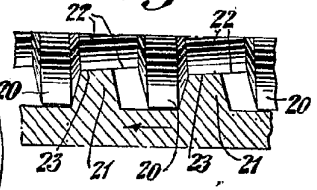
Fig.11.

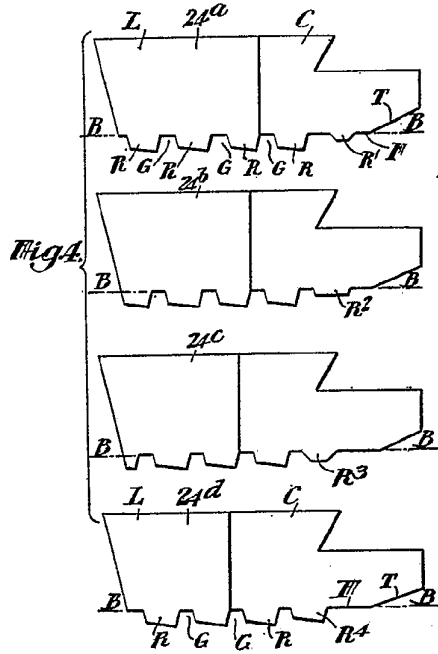
Melby & Sons' Photo-Litho

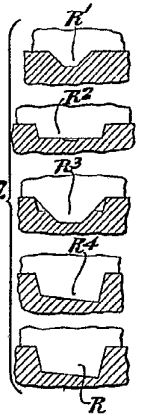
[This Drawing is a reproduction of the Original on a reduced scale.]

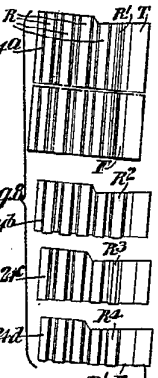


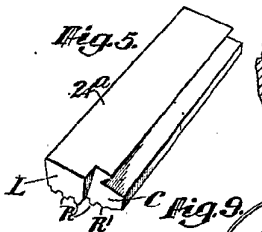


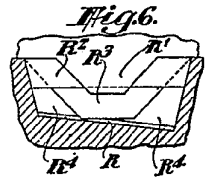


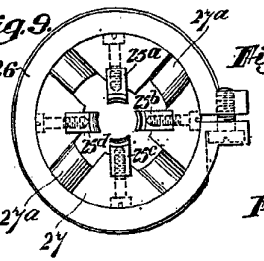


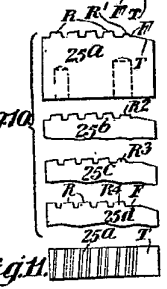












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